Testing and Validation of the Group 2 Location Calibration Consortium Regional Pn and Sn Calibration Phase 1 Delivery in Western Eurasia, the Middle East, Northern Africa, and Europe

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Seismic event location in Western Eurasia, the Middle East, Northern Africa, and Europe were improved using calibrated Pn and Sn travel times from a global 3D upper mantle velocity model. Regional path-dependent travel time corrections (i.e. Source Specific Station Corrections, SSSCs) were tested and validated. Reductions in location bias and 50% error ellipse area were achieved while retaining 90% coverage. The new calibrated regional travel times meet or exceed metrics and criteria recommended by the 1999 Oslo Location Workshop. Online tests with automatic and interactive processing software used at the IDC were conducted to assure compatibility. SSSCs for 63 IMS stations were then approved by the Center for Monitoring Research Configuration Control Board (CCB) for automatic and interactive event location processing.

The Group 2 Location Calibration Phase 1 delivery is based on a global 3D crust and upper mantle model from Colorado University Boulder, CUB1.0, constructed by inverting group and phase velocity data. Pn and Sn SSSCs were computed out to 20 degrees from each station by ray tracing. Modeling errors were initially estimated from residuals using the EHB catalog of arrivals w.r.t. CUB1.0. Direct comparisons were then made between the new model-based corrections and empirical corrections from cluster analysis. These comparisons indicate that the new modeling errors are conservative and capture 44% of the variance of the empirical path corrections at 47 event clusters.

Reference GT events were relocated to validate calibrated travel times, validate prediction errors, and demonstrate location improvement. Tests were conducted with calibrated regional phases alone, as well as calibrated regional phases mixed with uncalibrated teleseismic phases. A network of IMS and IMS surrogate stations was then used to demonstrate expected location improvements and reduced confidence ellipses in a future sparse IMS network. The 3D model-based SSSCs also showed good agreement with existing 1D SSSCs in Fennoscandia and Northern Russia.

The a-priori model variance was reduced about 50%, compared to the default IDC regional modeling error. Consequently, error ellipses areas are reduced by 50%, and the relative weighting of regional phases are increased. Conservative modeling errors assured 90% coverage. Calibrated travel times reduced location bias and uncertainty. Relocations of 571 GT0-GT10 events demonstrated statistically significant mislocation reduction. The majority of the events are improved. Degradation is less than expected, accounting for uncertainties in GT data, measurement and modeling errors. Calibration resulted in more consistent seismicity, reduced Pn and Sn misfits, and reduced origin time errors.